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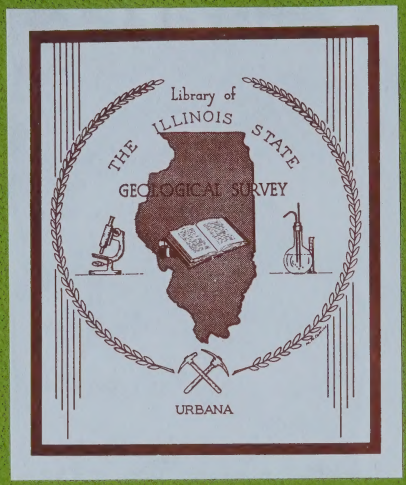
STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES

MARYLAND GEOLOGICAL SURVEY

TEN YEAR REPORT
1969 - 1979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THE ILLINOIS STATE
GEOLOGICAL SURVEY
URBANA

MEMORANDUM

TO: News Editor

FROM: James B. Coulter, Department of Natural Resources

SUBJ: 10th Anniversary Report

The Maryland Department of Natural Resources marked its 10th Anniversary during 1979, and to commemorate this occasion, a series of reports has been prepared detailing the activities of the Department on behalf of the people of Maryland.

The attached report describes the work of the Maryland Geological Survey.

It is our hope that this information will be of interest to you and that you will be able to share it with your readers. If you have any questions or need additional information concerning these reports, please call William Jabine in Annapolis at (301) 269-3683.

JBC/s

This is the fifth in a series of articles describing the activities of the Maryland Department of Natural Resources during the 10 years since its creation on July 1, 1969.

MARYLAND GEOLOGICAL SURVEY

When the Department of Natural Resources was created in 1969, the Maryland Geological Survey had already provided 73 years of continuous service as an independent State agency dealing with Maryland's geology, mineral and water resources.

Housed since its inception in 1896 on the campus of The Johns Hopkins University, the Survey functions as a primary source of geological information for the Department of Natural Resources and other state agencies, county and city governments, private firms and residents of the State.

Through scientific investigation and analysis, the Survey seeks to obtain a better understanding of the State's geology, archeology, water resources and mineral resources and to apply this knowledge to solving practical problems affecting everyday living.

The growth of Survey activities from 1969 to 1979 reflects the increasing importance attached to its mission to investigate the geologically-related resources of Maryland.

This expansion is evidenced by the growth in funds and the increase in staff described in Tables 1 and 2.

Table 1. Funds expended from all sources, 1969-1979

	1969	1979
General Direction	$ 72,431	$ 230,243
Hydrogeology and Hydrology	166,330	612,942
Environmental Geology and Mineral Resources	76,096	177,994
Coastal and Estuarine Geology	27,989	370,749
Division of Archeology		99,281
Total	$342,846	$1,491,209

Table 2. Staff (professional and support) 1969-1979
(merit system and full-time contractual)

	1969	1979
General Direction	5	7
Hydrogeology and Hydrology	2	4
Environmental Geology and Mineral Resources	5	8
Coastal and Estuarine Geology	2	14
Division of Archeology	-	6
Total	14	39

Summary of Activities

With the creation in 1969 of the Department of Natural Resources, a Division of Archeology was established in the Maryland Geological Survey and a State Archeologist employed. The Division of Archeology has considerably expanded its activities and has served as a catalyst for archeological activities throughout the State (see section on Archeology).

In 1969 the Survey was responsible for regulatory natural resource management functions including the Maryland Bureau of Mines and the regulation of oil and gas well drilling. In 1975 the Bureau of Mines was transferred to the new Energy and Coastal Zone Administration as were the regulatory activities dealing with gas well drilling. This move allowed the Survey to concentrate on its major mission of producing scientific reports and maps relating to Maryland's water and mineral resources and geology. During the period that the Survey was responsible for the Bureau of Mines, a new coal strip mining law was enacted and implemented; the Land Reclamation Committee was established and developed into a significant instrument of reclamation policy for the State.

In 1971, the General Assembly passed a resolution asking the Department of Natural Resources to study the supply and availability of mineral resources and their relation to other land uses and to study

ways to minimize the effects of surface mining. The Survey was assigned responsibility for this study and submitted its report entitled, Mineral Resources - Supply, Availability and Environmental Effects to the Legislative Council in 1971. This report provided background for the legislation enacted in 1975 which governs the reclamation of minerals other than coal.

For many years Survey activities relating to the Chesapeake Bay focused largely on the measurement of shore erosion rates and providing technical services to landowners who were experiencing problems of shore erosion. In 1971 the Coastal and Estuarine Geology Program was established in the Maryland Geological Survey and its activities have been broadened to include a Chesapeake Bay Earth Science Study (CBESS).

This study is an attempt to geologically map the bottom of the Chesapeake Bay, to determine the mineralogy and physical properties of the sediment on the bottom and near surface subbottom, to establish geochemical baselines for the bottom sediment and pore waters contained therein, and to discover the relationships among the bottom dwelling organisms and the sediments and pore waters. (See section on Chesapeake Bay Earth Science Study.)

The decade of 1969-79 saw a great rejuvenation of geologic mapping activities in Maryland. Although much of Maryland was covered by 1 inch= 1 mile county geologic maps prior to 1969 and the Survey had published a 1:250,000 scale Geologic Map of Maryland in 1968, virtually no detailed 7.5 minute quadrangle maps were in existence. During the past decade, and the several years preceding 1969, most of Baltimore County and Carroll County and parts of Frederick, Howard, Charles and Prince George's Counties have been geologically mapped at the 7.5 minute quad-

rangle scale. In addition to the 7.5 minute quadrangle mapping, new county geologic maps were prepared for a number of counties; mineral resources mapping was expedited; modern topographic maps were surveyed on the Eastern Shore; an aeromagnetic map of the State was published, and environmental geologic mapping was greatly expanded. (See section on Geologic Mapping and mineral resources.)

Water resources investigation during the past decade has been characterized by a greatly expanded effort in developing modeling techniques to define and analyze aquifers. These modeling methods were developed to provide the water resource planners and managers with predictive data on the quantities of ground water available as well as the effects of pumping an aquifer over a long period of time.

Another major trend in the Survey's water resources effort has been the development of detailed 7.5 minute quadrangle maps which depict the hydrogeologic constraints bearing on individual ground-water supplies and disposal systems. (For additional details see section on Hydrogeology and Hydrology Program.)

Publications

The basic products of the Maryland Geological Survey are reports and maps. They represent the culmination of the effort that has gone into geologic and environmental mapping, hydrogeologic studies and mapping, mineral resources studies and mapping, topographic mapping, Bay studies and mapping, and archeological studies. During the past decade the Survey has published a total of 107 reports and maps. (See Appendix.)

HYDROGEOLOGY AND HYDROLOGY

The Hydrogeology and Hydrology Program operates in cooperation with the U.S. Geological Survey (USGS).

As with other programs of the Maryland Geological Survey, the Hydrogeology and Hydrology Program is strongly oriented toward applied aspects of research. Thus the program is largely involved in identifying and defining the location, quantities, quality, and availability of water resources (groundwater and surface water) of the State. The measurements of long term trends in groundwater and surface water quantity are also of vital concern. These objectives are addressed by maintaining a statewide water data network and by conducting hydrogeologic studies in all areas of the State.

Funds and services budgeted in the Maryland Geological Survey are matched on a 50/50 basis by the U.S. Geological Survey (USGS). Local funding (counties, cities, bi-county agencies) is also sought in cases where projects include the water resources of a given jurisdiction. In such cases local funds are matched by general funds from the Maryland Geological Survey and the combination is matched by the USGS.

In the ten years covered by this report, funds expended from all sources (including matching federal monies) in the cooperative program have grown from $332,660 in 1969 to $1,225,884 in 1979. Currently only four full-time Maryland Geological Survey employees are assigned to this program reflecting the fact that most of the projects are carried out by federal geologists and hydrologists in the Maryland district office of the USGS.

The following summarize the highlights and trends in this program during the 1969-1979 decade:

Stream Gaging Network - In 1971, the Maryland Geological Survey issued a report on the "Flow Characteristics of Maryland Streams", which compiled data through 1967. The report contained annual discharge, magnitude and

frequency of high and low flows, and flow-duration data for 112 long-term continuous record stream gaging stations. The report has been in constant demand since its publication and is now virtually out-of-print. Since this report was issued, the data base has expanded to include approximately 140 continuous record sites, 30 peak-flow partial record sites, and 120 low-flow partial record sites. Rather than reprint the report the Maryland Geological Survey has requested the USGS to prepare a new report reflecting the significant flood events (e.g. Hurricanes Agnes and Eloise) that occurred between 1968 and 1978. The new report will also provide a technique for estimating low-flow characteristics at sites on ungaged streams.

Ground-Water Observation Wells and Coastal Plain Aquifer Model - Conceptual advances during the past decade have made it possible to solve complex aquifer problems using computers. These modeling methods provide the hydrogeologist with a powerful research tool to define ground-water flow systems. Once calibrated and verified the aquifer models can yield predictive data useful to water resource planners and managers.

To take advantage of this potential the Program moved in two directions: First of all, efforts were made to bring into the Program, on both the State and Federal sides, personnel trained in modeling techniques. As a result, the Program has developed and successfully field-tested a cost efficient, multilayer model which should be widely applicable to Coastal Plain aquifers. The model was used to evaluate the fresh-water flow system at Ocean City and is documented in a Maryland Geological Survey report entitled - "A Quasi Three-Dimensional Finite-Difference Ground-Water Model with a Field Application" (1979).

While the Program was developing a multi-layer modeling capability,

two aquifer projects were concluded using USGS's two-layer model. Reasonable calibration was achieved in both cases and the models were used to evaluate the impact future pumpage would have on current water levels. The results of these studies have been published by the Maryland Geological Survey and appear in reports entitled - "Digital Simulation and Prediction of Water Levels in the Magothy Aquifer" (1977) and "Simulated Changes in Water Level in the Piney Point Aquifer in Maryland" (1979).

As suggested above, aquifer models become useful only after their output can be calibrated against field data. Thus, the second major effort the Program initiated during the decade was an expansion of its observation well network, which increased from about 100 wells to over 350. Although the increase was largely achieved by gaining access to existing wells, the Program drilled about 50 new observation/test wells at strategic locations on the Coastal Plain.

In addition to water-level data, accurate pumpage information is required to successfully model an aquifer system. Through its participation in the National Water Use Data System (NWUDS) the Program will have better access to these data in the future.

Hydrogeology of Consolidated Rocks - At the beginning of the decade emphasis was placed on regional studies to define the hydrogeological characteristics of major rock systems. A series of reports followed, including - "Ground-Water Occurrence in the Maryland Piedmont" (1969); "Hydrogeology of the Carbonate Rocks, Frederick and Hagerstown Valleys, Maryland" (1973); and "Hydrogeology of the Triassic Rock of Maryland" (1975). With this phase completed more detailed quadrangle-scale (1 inch = 2000 feet) mapping was initiated in several Piedmont Counties

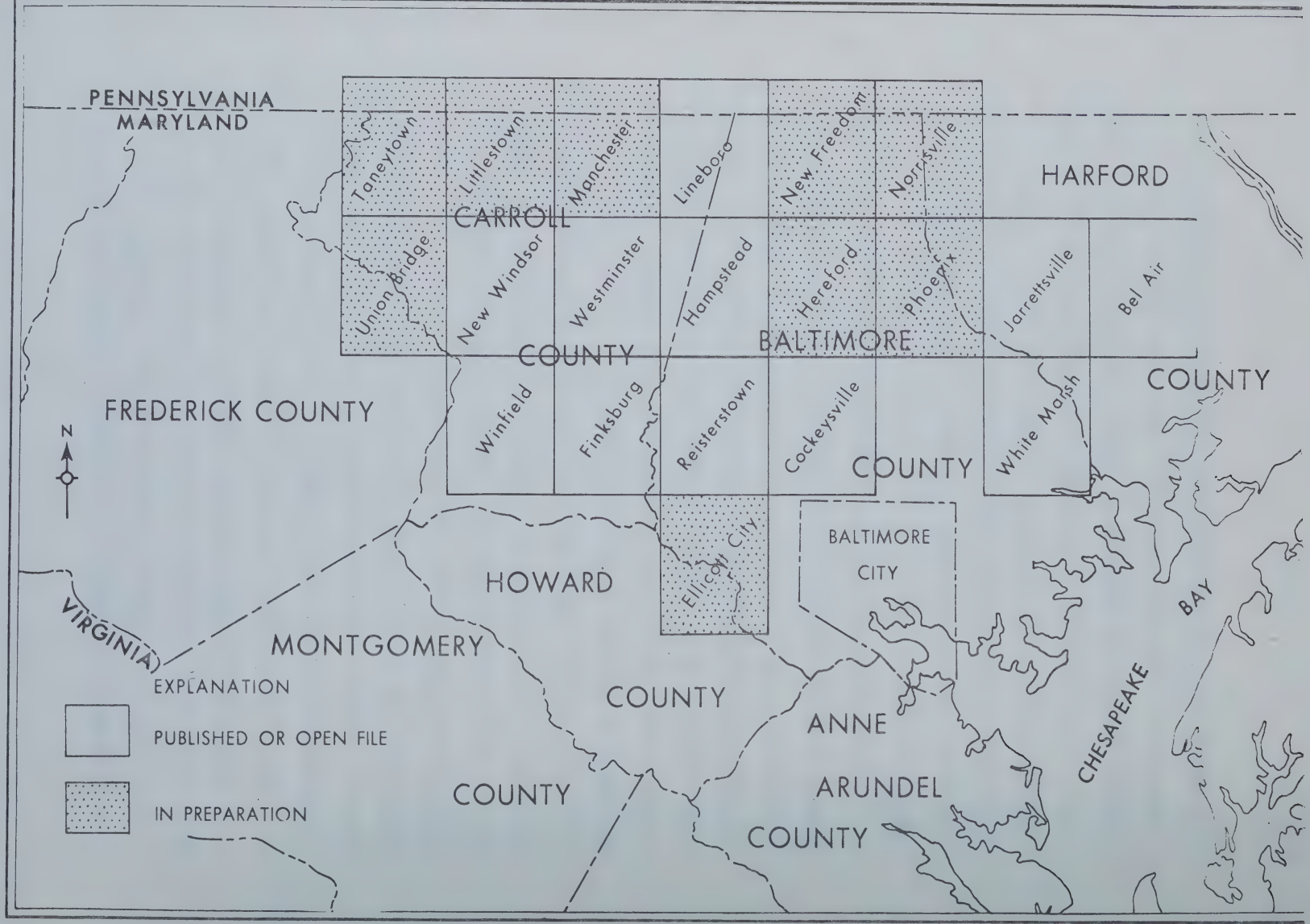

PENNSYLVANIA
MARYLAND
Taneytown
Littlestown
Manchester
Lineboro
New Freedom
Norrisville
HARFORD
CARROLL
Union Bridge
New Windsor
Westminster
Hampstead
Hereford
Phoenix
Jarrettsville
Bel Air
COUNTY
BALTIMORE
COUNTY
FREDERICK COUNTY
Winfield
Finksburg
Reisterstown
Cockeysville
White Marsh
COUNTY
N
Ellicott City
BALTIMORE
CITY
HOWARD
VIRGINIA
MONTGOMERY
COUNTY
BAY
CHESAPEAKE
ANNE
ARUNDEL
COUNTY
COUNTY
EXPLANATION
PUBLISHED OR OPEN FILE
IN PREPARATION

FIGURE 1

to better define the hydrogeologic constraints bearing on individual water supply and waste disposal systems. Each quadrangle is being prepared in an atlas format and usually consists of five maps: 1) Location of wells; 2) Depth to water table; 3) Availability of ground water; 4) Land slope map; and 5) Constraints on installation of septic systems. At the decade's end field work has been completed for 9 quadrangles in Carroll County, 8 in Baltimore County, 2 in Harford County, and 1 in Howard County (Figure 1).

Lastly, the Program has instrumented three small drainage basins in Howard, Washington, and Garrett Counties to collect detailed precipitation, stream flow, and ground-water level data. It is hoped that these data can be used to field verify a rock-aquifer model which the Program is currently developing. If successful, the digital modeling techniques now being applied to the Coastal Plain aquifers may prove to be useful elsewhere in the State.

ENVIRONMENTAL GEOLOGY AND MINERAL RESOURCES

Through research and mapping, this Program determines the geologic framework of the State, a framework which provides the basic information needed to determine the State's mineral resources, evaluate its ground water assets, and generate earth science data necessary for the wise management of Maryland's natural resources. During the decade the Program staff has modestly increased from five to seven, and its budget from $76,096 to $177,994.

Geologic mapping emphasizes both county (1:62,500 scale) maps and 7.5 minute quadrangles (1:24,000) (Figure 2). New county maps have been published for Baltimore, Washington, Wicomico, and Worcester, and are in preparation for Cecil, Dorchester, and Somerset. Twelve quadrangle maps

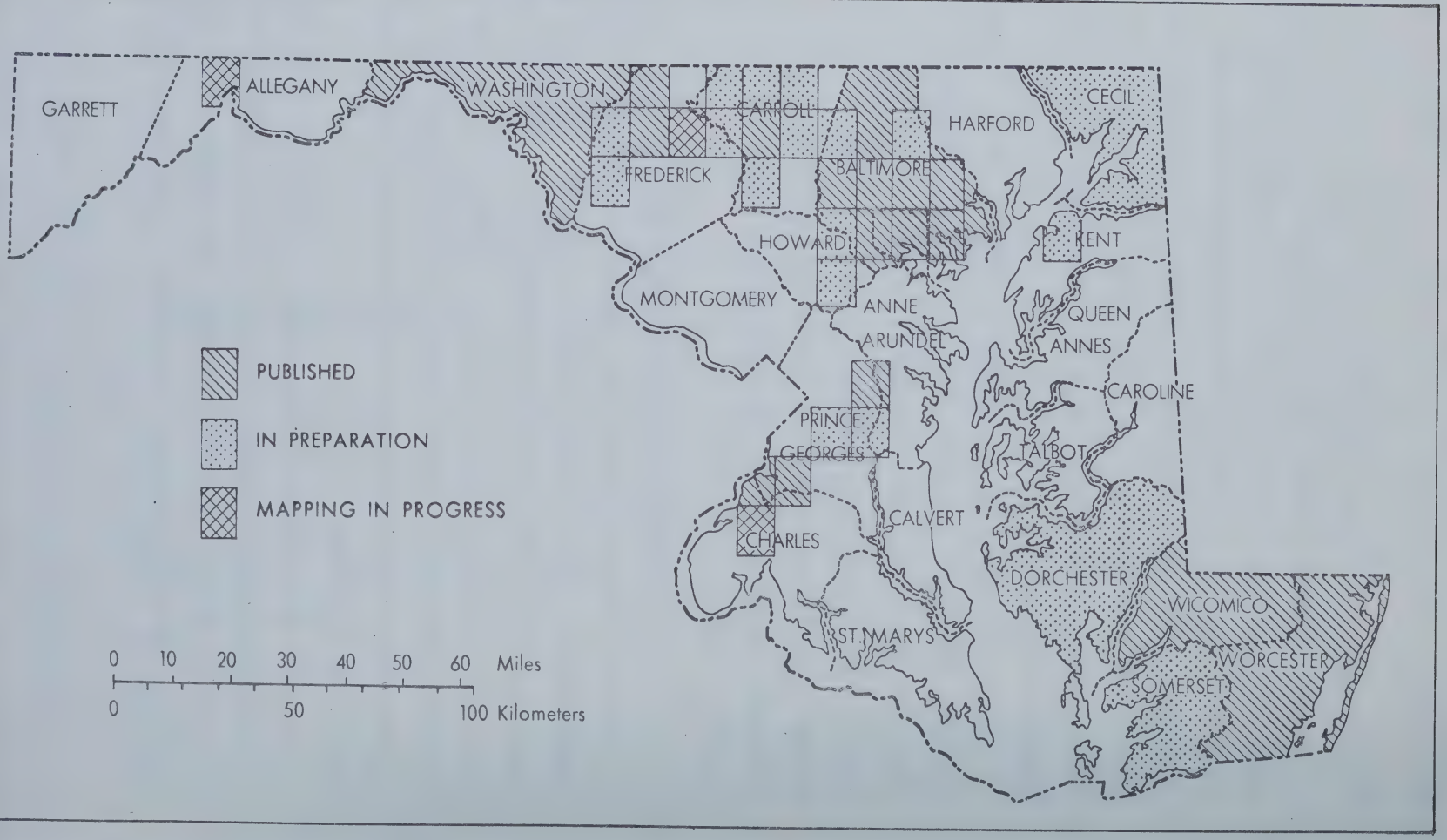


FIGURE 2 - Geologic Mapping 1969-1979

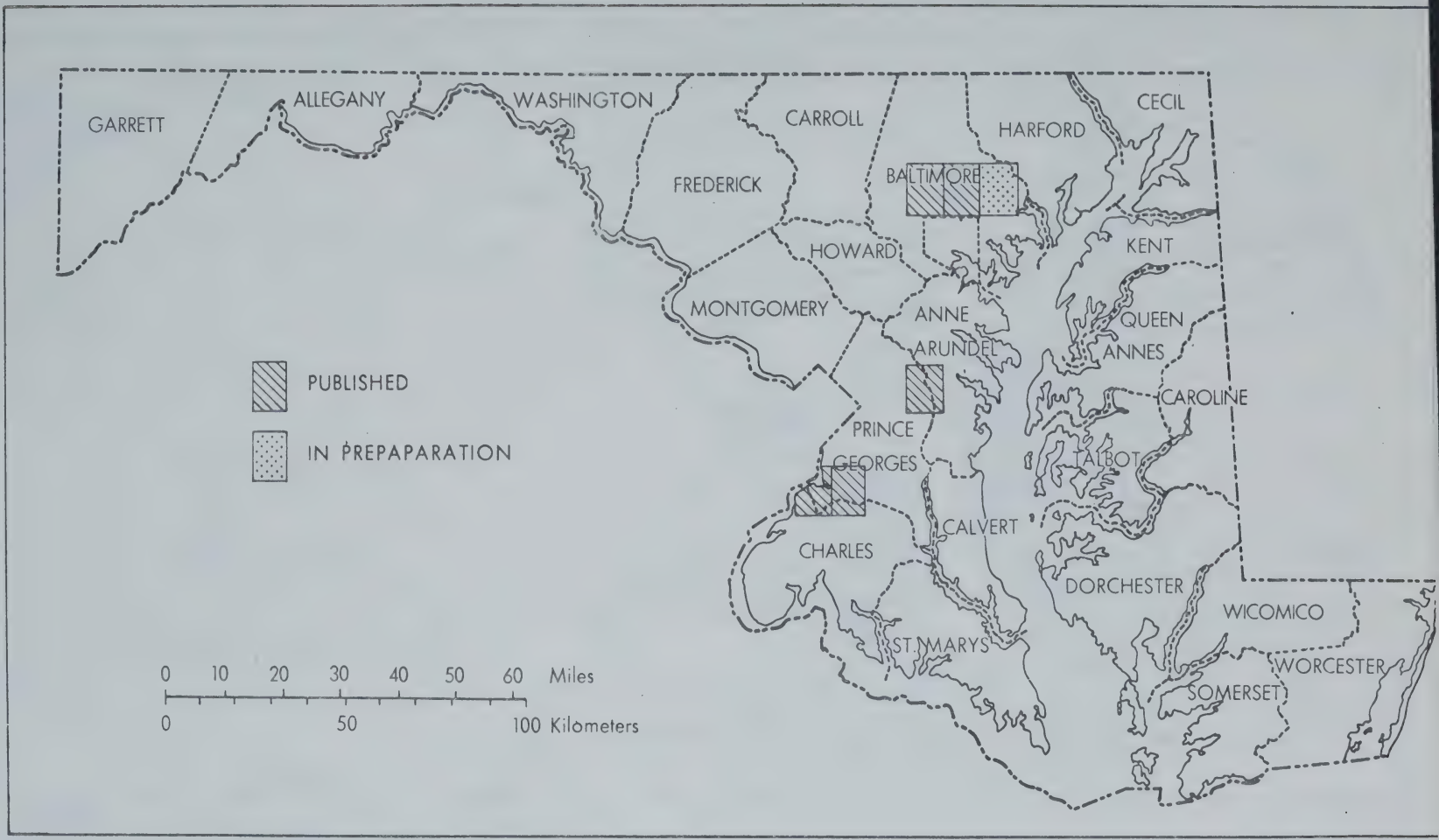


FIGURE 3 - Quadrangle Geologic and Environmental Atlases 1969-1979

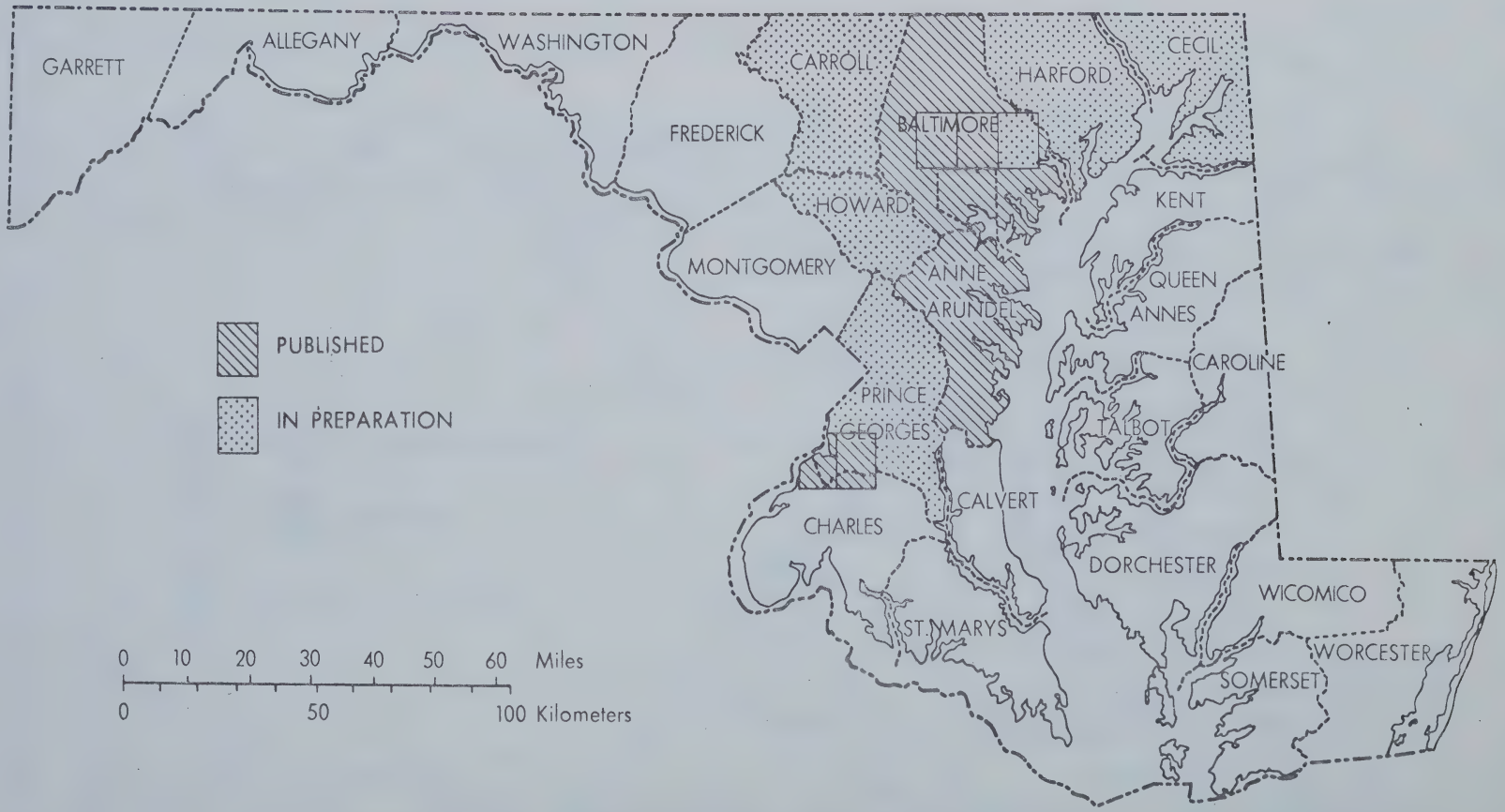


FIGURE 4 - Mineral Resource Mapping and Mined Land Inventory 1969-1979

FIGURE 5 - Aeromagnetic Mapping 1969-1979

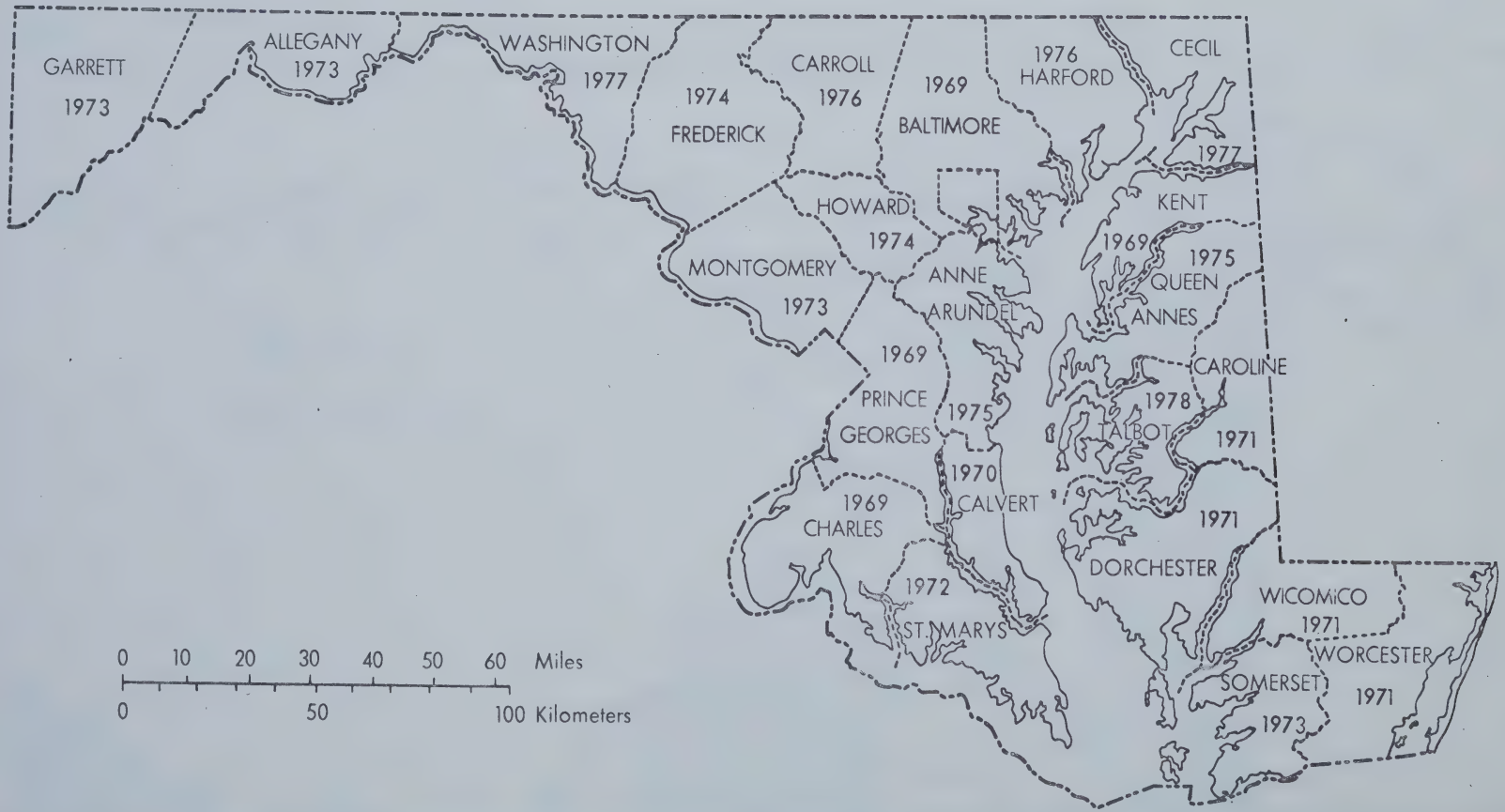


FIGURE 6 - Current Editions of County Topographic Map Series

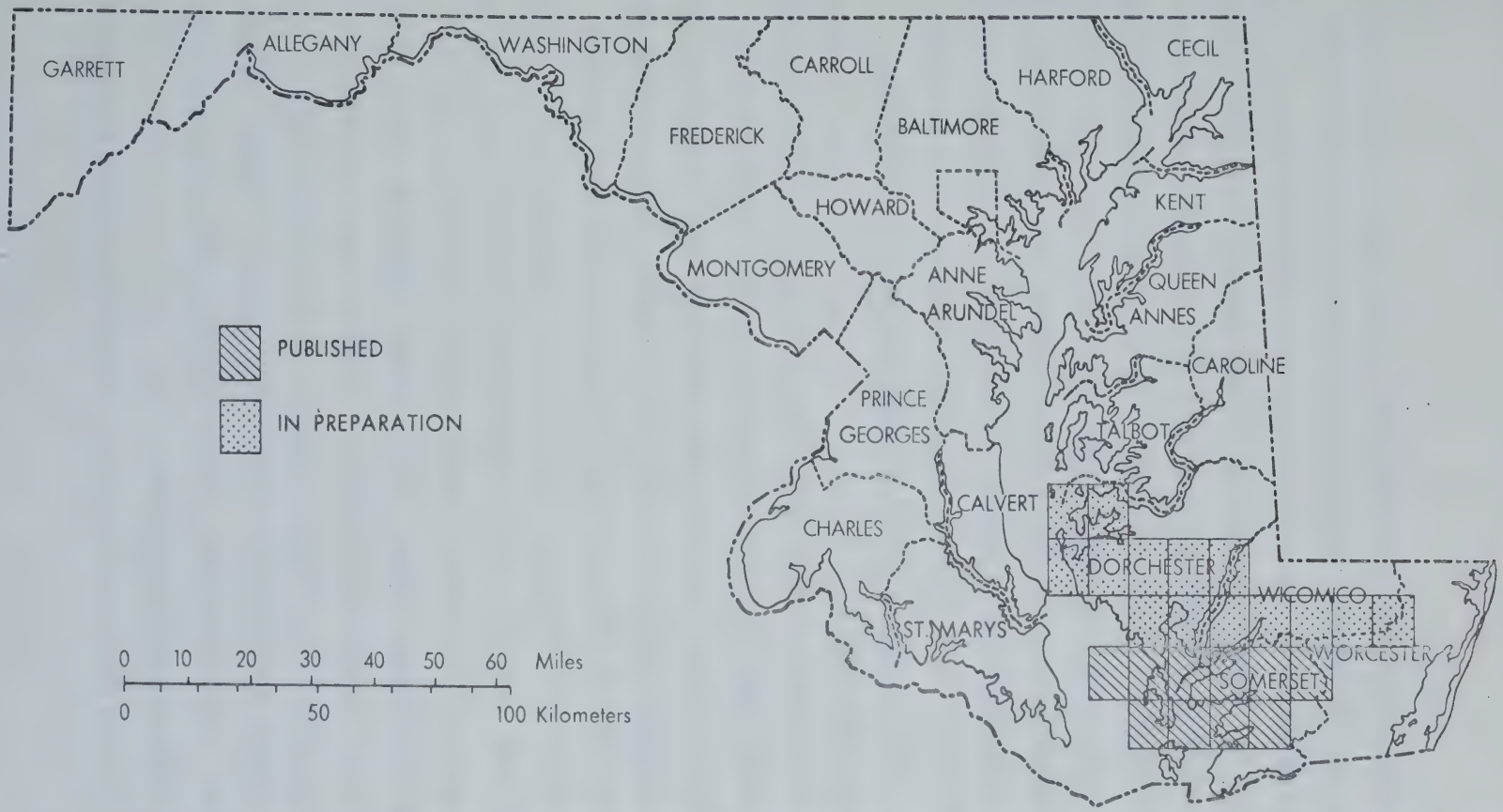


FIGURE 7 - New Topographic Mapping (Eastern Shore) 1969-1979

have been published, and eighteen are in various stages of preparation. Based upon the geologic mapping six geologic and environmental atlases have been prepared (Figure 3) and five mineral resource quadrangles (Figure 4). Seven county maps of mineral resource and mined land inventory are either published or in preparation. In cooperation with the U.S. Geological Survey a State aeromagnetic map has been published, and much of the State also mapped at 1:62,500 (Figure 5).

Topographic mapping and revision has been a continuing activity, and all of the County Topographic Maps have been revised at least once during the decade (Figure 6). In cooperation with the U.S. Geological Survey, new 7.5 minute quadrangle topographic maps are prepared and published (Figure 7).

The Program staff coordinates with agencies of the federal and state governments regarding geological aspects of oil and gas exploration on the outer continental shelf and geothermal exploration in Maryland. The staff prepares statistics on the mineral industry in Maryland in cooperation with the U.S. Bureau of Mines, and advises the Maryland Bureau of Mines on gas well drilling.

Program geologists have prepared numerous reports on geological research, as well as general interest papers and guidebooks on various aspects of Maryland's geology. Published maps and reports are the end product, and in the past decade they include: 6 reports of investigation, 16 information circulars, 4 guidebooks, 7 quadrangle geologic maps, 5 county geologic maps, 3 quadrangle atlases, Aeromagnetic Map of Maryland, 1 county slope map, 45 quadrangle slope maps, and 4 pamphlets.

Outer Continental Shelf Activities

The Survey has been tracking the oil and gas activities on the outer

continental shelf (OCS) since the inception of the leasing program. The first mid-Atlantic sale (#40) was held in August 1976 and netted the United States government $1.1 billion in income, the sixth largest total bonus in the fifty-two sales held since OCS leasing began in 1954. Drilling was delayed from the latter part of 1976 to early 1978 due to litigation. After industry drilled two dry holes, Texaco announced a possible gas discovery in July 1978. Subsequent drilling of thirteen additional holes added only one more possible gas discovery, probably on the same structure as the Texaco well. As a result, rig activity has decreased from nine to three in mid-Atlantic waters.

The second mid-Atlantic sale (#49) was held in February 1979 and netted the federal government only $40 million, reflecting the declining interest by industry in the Baltimore Canyon.

The third (#59) and fourth (#76) sales have been proposed for the mid-Atlantic area in December 1981 and November 1983, respectively. The call for nominations area for sale #59 has been extended westward to the state boundaries (three-mile offshore line) but leasing this close to shore will be tempered by present drilling results.

Geothermal Activities

In early August 1977, plans were being formulated for a geothermal program to include a number of shallow test holes in the Atlantic Coastal Plain, terminating in a deep well to be drilled at the most opportune location as determined by heat flow measurements. The Virginia Polytechnic Institute (VPI) provided the scientific advice and well location, Gruy Federal was the operator and the U.S. Department of Energy (DOE) funded the drilling of nearly fifty wells beginning in New Jersey and extending through the Coastal Plain to North Carolina. Five wells in

Maryland, followed by eight more, were drilled to 1,000 feet for making heat flow measurements. From these tests, VPI/DOE elected to drill the deep test at the Crisfield Airport. The well was drilled in early May to a total depth of 5,562 feet. The best sand aquifer had a calculated flow rate of 375 gallons per minute and a water temperature of about 133^{o} F was measured. Although the flow capacity was apparently sufficient, the temperature was less than anticipated and the planned long-term flow test was cancelled. The well was abandoned for geothermal purposes on July 6, 1979.

Additional deep tests may be drilled in Maryland, perhaps nearer a larger metropolitan area such as Salisbury for optimizing the market for utilization of geothermal energy.

COASTAL AND ESTUARINE GEOLOGY

The Coastal and Estuarine Geology Program has evolved at a greater rate than any other program of the Survey. At the beginning of the decade this Program was known as Shore Erosion Investigations and was devoted almost exclusively to measuring shore erosion along the Atlantic and Chesapeake Bay shorelines and to providing technical assistance to property owners experiencing shore erosion problems. By the early 1970's the program was renamed Coastal and Estuarine Geology and its objectives expanded to include the study of processes of sediment movement in the near shore environment.

Chesapeake Bay Earth Science Study

In 1976 the Survey embarked on the Chesapeake Bay Earth Science Study (CBESS) to assist the continuing effort to monitor the condition and health of the Chesapeake Bay.

The objectives of the study are to: 1) determine the physical

characteristics and behavior of sediments in the estuarine system, 2) determine the geochemical processes affecting the sediments and their pore water, and 3) examine the relationship between the benthic communities and the chemical and physical characteristics of the sediment in which they reside.

This study represents the first baywide comprehensive scientific examination of the physical and chemical characteristics of the Bay bottom. Results will be published in various reports of the Maryland Geological Survey and will also result in a series of maps which will depict: 1) sediment distribution, 2) pore water chemistry, 3) areas of sediment deposition, 4) areas of sediment erosion, 5) distribution of carbon and sulfur in sediments, and 6) benthic species diversity.

The published products resulting from this effort will aid in managing the Bay resources by contributing to decisions regarding: 1) beach restoration, dike disposal, overboard disposal and land disposal of spoil; 2) potential sites for new oyster bars; 3) placement of shore erosion control structures; 4) the siting of major facilities along or near the shores of Chesapeake Bay; 5) delineation of shoaling areas which will aid in placement of marinas; 6) identification of sediment source areas and effects of agricultural practices and urban development; and 7) determination of the role of benthic organisms in the exchange of dissolved species (e.g. trace metals) across the sediment water interface.

Because deposited sediments tend to remain in place and are not as subject to rapid change as the water in the Bay, this study should provide a baseline against which future changes can be measured (e.g. oil spills, pollutant discharge, effects of hurricances). Thus, such a study

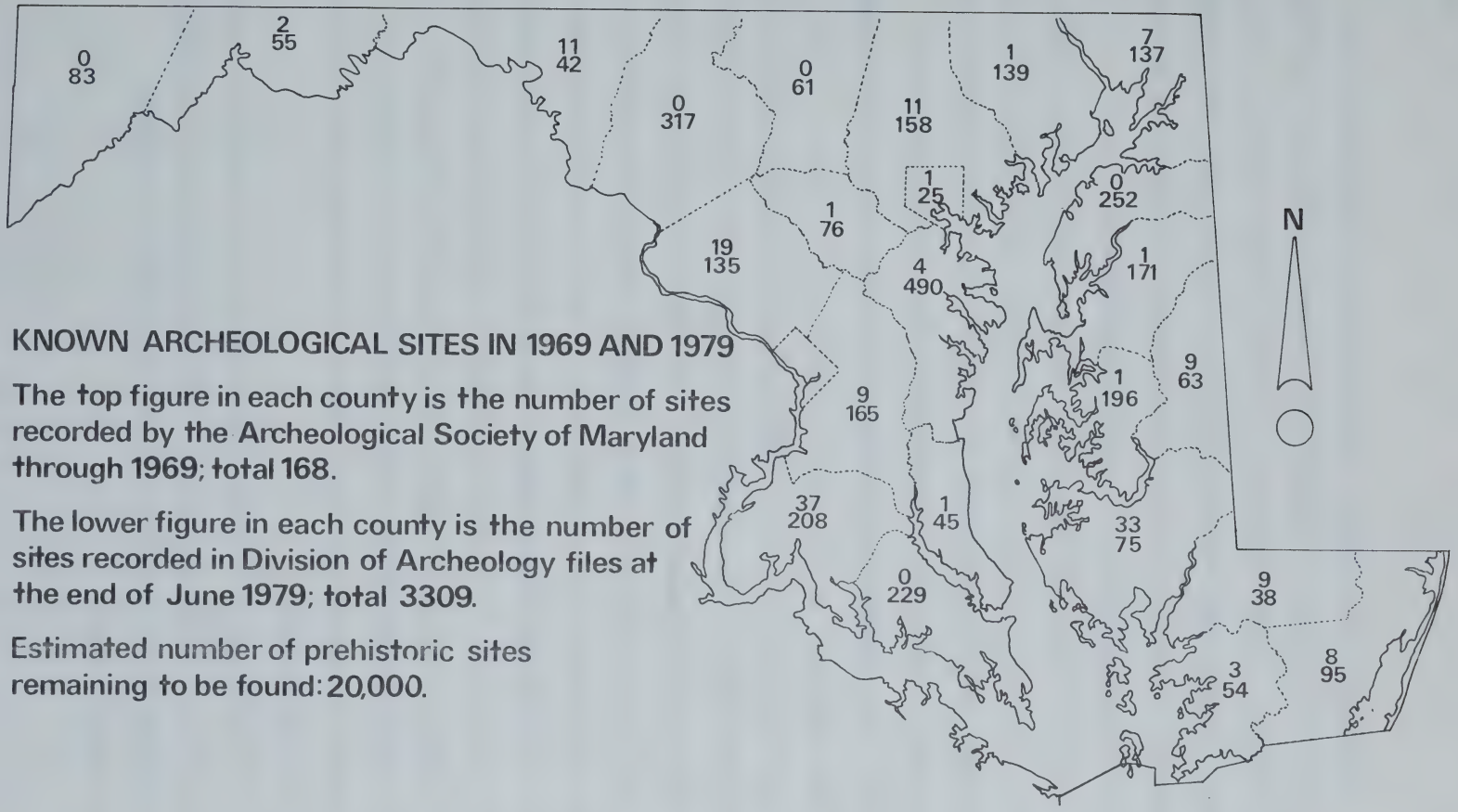
is critical to efforts to evaluate the condition of the bay.

Initially, CBESS was supported by funds and services from the Maryland Geological Survey, Energy and Coastal Zone Administration and Capital Programs Administration. In fiscal year 1979, the Survey received a $682,000 two-year grant from the Environmental Protection Agency which allowed CBESS to accelerate and expand as well as purchase badly needed, sophisticated analytical instruments for laboratory and field work. The Bay Study is staffed with twelve professionals (including geologists, geochemists and biologists) and a secretary.

DIVISION OF ARCHEOLOGY

The Division of Archeology was activated in August 1969 following passage of the Maryland Archeological Resources Act in 1968 (Code: Natural Resources, 2, 3). The Division is mandated to coordinate archeological activities in Maryland, encourage archeological research and preservation, publish reports on Maryland archeology, and enforce regulatory sections of the Archeological Resources Act.

During its first three years the Division was staffed only by the State Archeologist and, at times, one part-time office/laboratory assistant and a summer student aide. However, the enthusiastic assistance of volunteers, especially on weekends and holidays, and the availability of a field vehicle and minimum equipment, enable the Division to inventory sites and collections throughout the state and to conduct several important salvage excavations. One of the latter investigations was north of Frederick at the Late Prehistoric Biggs Ford Indian Village, an area scheduled for partial disturbance by a wastewater interceptor. Another salvage excavation, carried out in cooperation with local citizens, was at the Reeves site near Salisbury.



KNOWN ARCHEOLOGICAL SITES IN 1969 AND 1979

The top figure in each county is the number of sites recorded by the Archeological Society of Maryland through 1969; total 168.

The lower figure in each county is the number of sites recorded in Division of Archeology files at the end of June 1979; total 3309.

Estimated number of prehistoric sites remaining to be found: 20,000.

FIGURE 8

Maintenance of a systematic record of archeological sites in Maryland has been a principle responsibility of the Division since its founding (Figure 8). Initial emphasis was placed on rapid inventory, but as needs and problems have become more complex in recent years, more complete information is needed and the Division is working with other archeologists in developing improved forms and recording procedures.

The Division has cooperated with the Archeological Society of Maryland since 1971 in helping to sponsor the annual Field Session in Maryland Archeology. The Session provides instruction in modern field and laboratory methods at sites that are subject to destruction and could not otherwise be investigated. The Division has prepared reports on a number of these projects.

Beginning intermittently in 1972, and regularly since 1975, the State Highway Administration has sponsored field investigations by the Division in connection with proposed highways. The initial project was for salvage at a Late Prehistoric Indian village partially destroyed by the National Freeway at Friendsville. But in concert with the national trend to emphasize conservation and management, subsequent work has involved background research and field surveys during early planning stages of proposed construction. Archeological survey and testing during 1975 and 1976 in the Northwest Transportation Corridor in Baltimore County included the most exhaustive regional research on industrial archeology that has been undertaken in Maryland.

The Division has also helped sponsor intensive archeological surveys in Kent County, initiated a technical publication series and a newsletter, and presented papers and talks at professional meetings and before service organizations.

Increased demands for project review and field investigations received some assistance from DNR's Land Planning Services in 1976 when they began to sponsor inventories of archeological resources on some of its holdings. Additional inventory and survey, including development of a predictive model for prehistoric site occurrence in the Monocacy River region, has been made possible since 1977 with annually increasing federal Heritage Conservation and Recreation Service Grant-in-Aics administered by the Maryland Historical Trust. Field studies on the Upper Chester River were sponsored by the U.S. Soil Conservation Service in 1978. The Grant-in-Aids and the State Highway Administration Agreement have enabled the Division to employ three archeologists and some part-time assistance in addition to the authorized force of two. Two additional specially funded positions began in FY 80.

The Division of Archeology has successfully maintained its primary responsibility of coordination, site recording, and research, while adjusting to a major change in direction of American archeology from problem oriented research to resource management. During the period of creation and initiation of the Division, state archeology programs traditionally focused on problem research, synthesis, and popularization through exhibits and publications. The focus has now changed to management research, coordination, and direct public involvement.

APPENDIX

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(published 1969-1979)

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